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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: Housing Comprising a Liquid-Tight Electric Bushing

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HOUSING COMPRISING A LIQUID-TIGHT ELECTRIC BUSHING

Background

[0001] The invention relates to a housing having a liquid-tight electric bushing, as generically defined by the preamble to claim 1.

[0002] The invention relates in particular to housings of X-ray emitters. In the X-ray emitters known from the prior art, an X-ray tube is received in a housing. For cooling the X-ray tube, coolant oil is circulated through the housing at an overpressure. Electric lines for triggering and monitoring the X-ray tube are guided through the housing wall by means of a closure which closes an opening in the housing in liquid-tight fashion. Especially because of the properties of the coolant oil, it repeatedly happens in practice that cooling oil creeps along contact pins that are cast integrally in the closure and emerges in an unwanted way on the outside of the housing. Aside from this, the production of conventional closures involves relatively great effort; they are expensive.

Summary

[0003] It is the object of the invention to eliminate the disadvantages of the prior art. In particular, an electric bushing for a housing is to be disclosed that can be produced as simply and economically as possible and that has improved tightness.

[0004] This object is attained by the characteristics of claim 1. Expedient features will become apparent from the characteristics of claims 2 through 28.

[0005] In accordance with the invention, it is provided that the closure is a printed circuit board embodied in multiple layers. Using a printed circuit board makes it possible to produce an electric bushing for a housing simply and economically.

[0006] Advantageously, the printed circuit board is mounted on the housing in such a way that a first layer, pointing toward the housing interior and forming a top side of the printed circuit board, spans the opening. Because the printed circuit board is mounted on the housing in such a way that a first layer, pointing toward the

housing interior and forming a top side of the printed circuit board, spans the opening, creeping of a liquid received in the housing through the printed circuit board is prevented securely and reliably. The proposed closure has improved tightness.

[0007] Advantageously, at least one first contact element is provided on the top side. The first contact element serves to connect at least one electric line received in the housing. The first layer is expediently produced from an electrical insulation material. It is thus assured that the closure is electrically insulated from the housing.

[0008] In a further feature, the first contact element is connected electrically to a second contact element via at least one conductor track, guided in the interior of the printed circuit board and forming a second layer. For contacting the first contact element, a blind bore reaching through the first layer and extending as far as the second layer is advantageously provided. The provision of a blind bore contributes to preventing the liquid received in the housing from being able to creep transversely through the layers of the printed circuit board.

[0009] The second contact element may be provided on an underside located opposite the top side. However, it may also be extended to the outside at an edge of the printed circuit board.

[0010] In a further feature, it is provided that the printed circuit board is flexible. This makes simple adaptation possible, for instance to non-plane geometries of the opening.

[0011] Advantageously, the printed circuit board has a plurality of second layers, located one above the other, of conductor tracks. In this case, the first contact element and the second contact element may be connected via a plurality of conductor tracks, located one above the other and connected to one another electrically conductively. Tightness under extreme loads can thus be assured.

[0012] In a further feature, it is provided that a seal is provided between the printed circuit board and the housing. Moreover, a pressure plate contacting the underside of the printed circuit board may be provided for pressing the printed circuit board against the seal. Such a pressure plate makes simple assembly possible.

Besides this, the printed circuit board can additionally be stabilized mechanically, for instance against an overpressure prevailing in the housing.

[0013] The proposed electric bushing is fundamentally suitable for many types of housings that are filled with a liquid. Examples that can be considered are motor housings and gearboxes, reactors for performing chemical reactions, the housings of heating and cooling systems, and the like. In particular, the proposed electric bushing is also suitable for producing an X-ray. In that case, an X-ray tube is received in the housing.

[0014] Also in accordance with the invention, the use of a printed circuit board as a closure for liquid-tight closing of an opening provided in a housing and as an electric bushing is contemplated.

[0015] With regard to the advantageous embodiment of the use, the aforementioned characteristics are referred to, which can logically likewise form embodiments of the use.

[0016] Exemplary embodiments of the invention will be described below in further detail in conjunction with the drawings. Shown are:

Brief Description of the Drawings

[0017] Fig. 1, a sectional view through a first exemplary embodiment; and

[0018] Fig. 2, a sectional view through a second exemplary embodiment.

Detailed Description of the Presently Preferred Embodiments

[0019] In the first exemplary embodiment shown in Fig. 1, a housing 1 has an opening 2. A printed circuit board 3 has a first layer 4, made from an electrical insulation material, which points toward the interior of the housing 1 and spans the opening 2. The first layer 4 forms a top side O of the printed circuit board 3. In the interior of the printed circuit board 3, in an arrangement one above the other, a plurality of electrically conductive second layers 5 are provided, which are electrically conductively connected to one another via a bridge 6. The second layers

5 are expediently likewise conductor tracks. An underside U of the printed circuit board 3, opposite the top side O, is formed of a third layer 7, which is again made from an electrical insulation material. A first blind bore 8 is provided in the first layer 4, and a second blind bore 9 is provided in the third layer 7. A first contact element 10 mounted on the top side O is connected electrically conductively to the second layer 5 by means of a first connection 11 that is guided by the first blind bore 8. A second electrical contact element 12 provided on the underside U is also connected electrically conductively to the second layer 5 by means of a second connection 13 guided by the second blind bore 9. The first contact element 10 and the second contact element 12 are preferably mounted by SMD (surface mounted device) technology on the printed circuit board 3.

[0020] A pressure plate 14 is mounted on the housing 1 by means of screws 15. The pressure plate 14 rests on the underside U of the printed circuit board 3 and presses the topside O, opposite the underside U, against an O-ring seal 16. The pressure plate 14 is preferably embodied such that it spans a substantial portion of the opening 2 and thus stabilizes the printed circuit board 3 against liquid overpressure prevailing in the housing 1.

[0021] In the exemplary embodiment shown in Fig. 2, the printed circuit board 3 is retained on the housing 1 by means of a cap 17. In this case, a portion of the printed circuit board 3 protrudes laterally out of the housing. Instead of the second contact element 12, the second layer 5 has a bent-over portion 18 on the edge that is extended out of the housing. This makes it possible to produce a connection, for instance by snapping a suitable flat plug onto the portion of the printed circuit board 3 that protrudes laterally from the housing.

[0022] As can be seen from Figs. 1 and 2, the opening 2 in each case is spanned by the first layer 4 of the printed circuit board 3. Only in the first layer 4 is a first blind bore 8 provided, which extends as far as the second layer 5. In particular, the printed circuit board 3 has no continuous opening whatever. As a consequence, creeping of coolant oil, for instance, along such continuous openings of the kind used in the prior art is securely and reliably prevented. The proposed electric

bushing can be realized simply and economically, using multi-layer printed circuit boards made by conventional techniques.